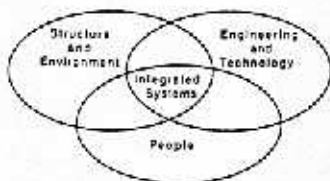




# MANPRINT BULLETIN



Vol. I No. 12

"Remember the Soldier"

June 1987



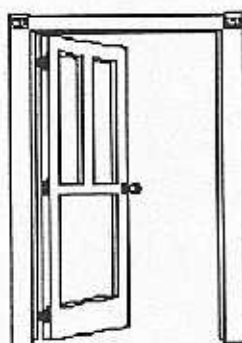
## Health Hazard Assessment: The Big Picture

by LTC Bruce C.  
Leibrecht

Editor's note: This is the first of a series of articles on the Army Medical Department's role in the MANPRINT Program.

As Army institutions go, the Health Hazard Assessment (HHA) Program is a relative "new kid on the block." Certainly, it is the youngest of the six domains under the MANPRINT umbrella. Although activities related to HHA were conducted by the Army Medical Department during World War II, the current program's official beginnings trace back to 1976, when questions about blast overpressure hazards surfaced in ASARC IIIa proceedings for the XM-198 howitzer. Since then the program has made great strides, playing a key role in the burgeoning MANPRINT arena. This article introduces the "new kid" and presents a quick overview of HHA. Future articles will flesh out major features, explain how the program works, and review biomedical research activities supporting the program.

A health hazard is defined as an existing or potential condition inherent to the use of materiel that can cause death, injury, acute or chronic illness, disability, and/or reduced job performance. Such a condition can stem from system design characteristics, environmental factors, doctrinal requirements, biogeographic factors, operational peculiarities, improper system usage, or system malfunction. Notice that performance aspects are included among the



Inside . . .

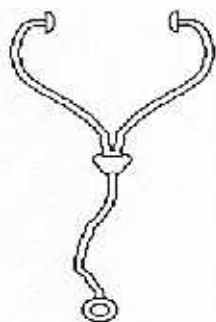
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adverse effects; the interplay between biomedical effects and performance effects can be substantive and complex. In civilian circles, HHA most closely relates to aspects of occupational health, preventive medicine, environmental medicine, and industrial hygiene. However, certain fundamentals, especially the emphasis on operator-system interactions and unique aspects of military operations, give the Army's HHA Program its own distinctive character.

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## Health Hazard Assessment

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The primary policy document covering the HHA Program is AR 40-10, published in 1983. Since the regulation assigns Army Staff responsibility for the program to The Surgeon General, it might be mistaken as strictly an Army Medical Department responsibility. In reality, the program depends critically on

both medical and nonmedical participants for successful implementation. The nonmedical participants include key Army General Staff agencies (especially the Office of the Deputy Chief of Staff for Personnel), the Training and Doctrine Command, the Army Materiel Command (including program and project managers), the human factors engineering community, and the system safety community. In terms of general approach and methods used, the HHA Program shares much in common with the Human Factors Engineering and System Safety Programs. The latter two have been closely involved in HHA activities for many years and continue to play important roles. For example, Human Factors Engineering Analyses and Safety Assessment Reports routinely address health hazard issues. Thus, it is clear that, as with the other domains of MANPRINT, HHA is clearly a teamwork affair.

The overall goals of the HHA Program are to contribute to force multiplication by conserving or enhancing fighting strength and to ensure successful Army modernization in a safe, efficient, cost-effective manner. Program objectives include (a) preventing combat casualties and performance decrements caused by routine operation of our own combat systems; (b) enhancing soldier performance and system effectiveness; (c) reducing health-related readiness deficiencies; (d) reducing system retrofit requirements; and (e) reducing disability compensation requirements. In terms of policy, HHA stresses key principles common to every MANPRINT domain: early and continuing involvement in system development; total system and total life-cycle evaluation; and emphasis on realistic empirical data for assessment efforts.

A wide variety of hazards can directly affect the soldier's health. For the Army's purposes, these can be organized into six working categories:

- Mechanical forces, including the following:
  - Shock (acceleration/deceleration)
  - Trauma (blunt and sharp/musculoskeletal)
  - Vibration (whole body/segmental)
  - Acoustical energy (steady state/impulse/blast overpressure)
- Chemical substances (weapons/engine combustion products and other toxic substances)
- Biological substances (pathogenic microorganisms and sanitation)
- Radiation energy (ionizing and nonionizing, including light and lasers)
- Temperature extremes and humidity (heat and cold injury)
- Oxygen deficiency (crew/confined spaces and high altitude).

More will be written in a future article about types of hazards and what to look for.

Exposure to one or more health hazards does not necessarily injure a soldier or make him sick. The effects of a hazardous environment depend on the

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## FDTE and EUT&E Enhance MANPRINT Operational Evaluations

by LTC Joe Bishop

Force development test and experimentation (FDTE) and early user test and experimentation (EUT&E) can be used to enhance the evaluation of MANPRINT issues during initial operational test and evaluation (IOT&E) and follow-on OT&E (FOT&E). These tests support the force development process by providing data to combat developers, testers, modelers, and materiel developers. FDTE and EUT&E can be used before formal operational testing

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## Health Hazard Assessment (continued from page 2)

intensity of amplitude, duration, number of repetitions, and other aspects of the exposure. The immediate functional impact on the soldier can range widely from negligible to complete incapacitation and even death. However, three general functional states can be distinguished: performance limited; physiologically distressed; and incapacitated. On the less severe end of the spectrum, sensory decrements and/or minor injury characterize performance-limiting effects, leaving the soldier capable of performing at a constructive level with, at most, minor medical attention. Examples of this category are minor hearing loss, mild hypoxia, and muscle strain. Moving toward more severe impacts, physiologically distressing effects seriously compromise the soldier's capability to perform his combat role. They frequently involve psychological distress<sup>1</sup> and/or moderate injury, and may require substantial medical attention. Examples of this category are dizziness, moderate nausea, and severe fatigue. Incapacitating effects render the soldier nonfunctional and incapable of caring for himself. Examples include carbon monoxide poisoning, combat exhaustion, and serious burns.

Many of the effects of health hazards are not immediate; they may appear only after months or years of exposure. While such effects may not immediately affect the soldier's performance, they can limit his long-term contributions to the Army and may cause serious health problems in the future. Examples of delayed or "chronic" effects include cancers, organ system disorders (e.g., liver or kidney damage), psychiatric disorders,<sup>1</sup> birth defects, and genetic mutations.

The next article in this series will address how the HHA Program works and will list points of contact for obtaining information and assistance. For additional information, contact LTC Bruce Leibrecht, U.S. Army Aeromedical Research Laboratory, Ft. Rucker, AL 36362, AV: 558-6913 or (205) 255-6913. ●

<sup>1</sup> Editor's Note: The psychological impact of exposure to one or more health hazards has not received the same degree of attention that the more obvious impacts of exposure have. However, the effects on human performance can be just as debilitating. Another area that needs additional attention is the psychological impact on human performance when the soldier does not have confidence in the equipment design. Examples include the failure of equipment to meet operational and reliability standards or to provide protection to the soldier.

## FDTE and EUT&E (continued from page 2)

to develop and refine testable soldier performance issues, measures of performance (MOP), and criteria. This article describes points of major interest and facts about these two procedures.



It is extremely difficult to write testable issues by using the six domains of MANPRINT as a checklist. They tend to be resource issues rather than performance issues, and any associated criteria tend to describe design characteristics of the system rather than functional or operational requirements. Therefore, focusing on soldier performance can improve the quality of issues and criteria.

As part of the issue development process, FDTE/EUT&E should focus on soldier performance measurements that are vital components of total system performance. The performance measurements of interest are described in greater detail than is normally found in individual training tasks, because they must be useful for diagnosing system performance problems noted during operational testing. MOP should be considered for all critical tasks done by soldiers, including operators, maintainers, and support personnel. MOP can be at the individual level or at the level of crews, teams, squads, and other functional groups, which may even cross unit boundaries.

Soldier performance issues should be written as part of system performance issues wherever possible. This is especially helpful in guiding OT&E diagnostic work when system performance is not up to par. It is also useful in ensuring that mistakes made in a previous system are not repeated in the new system.

Soldier performance issues should not be omitted merely because criteria cannot be stated. The state of the art may not be sufficiently developed to identify soldier performance criteria, but soldier performance

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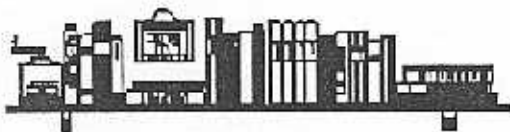


## FDTE and EUT&E (continued from page 3)

issues (and potential MOPs suitable for addressing those issues) should be written anyway. As FDTE and EUT&E progress and the system matures, efforts to identify MOPs may result in the development of soldier performance criteria.

These tests should also be used to design optimum organizational structures by testing alternative organizations, military occupational specialties (MOS), skill levels, and so forth, and to design optimum training programs by testing training alternatives. This is important because formal OT&E can only minimally confirm manpower and personnel data in the Table of Organization and Equipment and cannot test alternative training programs at all.

For more guidance on conducting FDTE and EUT&E, see the revision to AR 71-3 dated 21 January 1986, and/or contact LTC Joe Bishop at the U.S. Operational Test and Evaluation Agency, Falls Church, VA 22041-5115; AV: 289-2487 or COM: (202) 756-2487. ●



## Book Review

### Lessons in Operational Suitability

by Kent Myers, Ph.D.

Stanley, William L., and Birkler, John L. *Improving Operational Suitability Through Better Requirements and Testing*. Project AIR FORCE Report #R-3333-AF. Santa Monica, CA: RAND Corporation, 1986.

This study makes full use of Air Force experience in aircraft development to show how operational suitability has been handled. Suitability characteristics were successfully identified and enforced for

the Advanced Tactical Fighter (ATF) and other items, but no projects were entirely successful and chronic problems remain. The lessons learned and concepts explored are fully applicable to the Army.

A major hurdle is simply defining operational suitability. DOD Directive 5000.1 defines it by listing most of the topics that are handled under ILS/RAM and MANPRINT. It can also be defined by describing what it is not. It is not to be confused with functional performance (i.e., speed, maneuverability, etc.). Rather, it is a measure of how the whole system succeeds in meeting military objectives when used in its intended context.

The authors show that the Air Force, when preparing the equivalent of a ROC, has offered only the vaguest statements regarding suitability. There are many reasons for this, such as not wanting to constrain designers, not having sufficient information to make estimates, not wanting to take attention away from functional performance characteristics, and fear of establishing a 'secondary' requirement that may be hard to change later. The authors found none of these reasons compelling. The problems were overcome in the ROC for the ATF, which "identifies as deficiencies such things as large support requirements when deployed, large specialized work forces, hard-to-handle materials, high failure rates, fault isolation problems, etc., that in various ways detract from mobility, sortie generation, and resilience to attack." The authors recommend quantifying these needs wherever possible. The quantities may be considered as goals rather than actual requirements in cases where estimates seem premature and uncertain. The important point is that measures of operational suitability, reflecting both user experience and recognition of new technical opportunities, should be introduced in initial documents so that they influence designers, are propagated in subsequent documents, and are fully considered in tradeoff studies.

The authors admit that there is no consistent strategy available for specifying operational suitability. However, they do offer a few principles. An important one is not to concentrate on subsystem performance (which relates to means rather than results) even though these measures are commonly understood and more easily tested. Such measures can cause

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## Lessons (continued from page 4)

the whole system to perform badly, and may constrain designers. System-level specifications "will become even more important in the future as fire control, propulsion, flight control, and navigation functions are increasingly integrated." Another principle is to include a description of realistic environments as a necessary component of these measures. The authors describe ten sample measures of military-oriented output capability, including sortie-generation rate, maintenance manpower, deployed support, and so forth.

The authors deal extensively with the practical problems of establishing reliability measures for complex equipment. Even where good measures are devised, they are often weakened or lost as new documentation is created. They suggest tracking suitability requirements through all documents using a baseline correlation matrix.

Operational requirements do not automatically become contractual specifications for the industries that make the equipment. The authors show that in some development programs more than 75 percent of the failures were not "contractually relevant," even though many of these failures could have been corrected by the designers. Contract requirements regarding failures should receive more attention from RFP preparers and should place more responsibility on the contractor for dealing with failure and adjusting incentive schemes appropriately. Operational suitability means much more than reliability, however. Characteristics that are more difficult to measure, such as mobility and resilience to attack, are recommended as topics for contract specifications.

The authors present valuable evidence that testing often does not address operational suitability, both because test environments are not realistic and because many requirements and potential problems are statistical in nature and cannot be adequately estimated in the brief, small tests that are usually run. Realizing that development schedules will not be lengthened, the authors review various alternative strategies for suitability testing, such as component testing, "maturation development," production stretch-out, and modeling.

This study offers many important observations about how the material development process fails to produce integrated systems. However, it is also a very hopeful study because it shows that, with effort, some of the difficult operational suitability criteria for which the MANPRINT community is responsible can be fit into requirement and solicitation documents, can be tested, and can influence design. ●

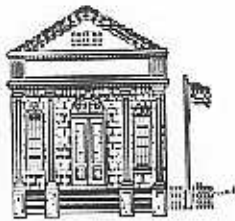
## Extended Epstein-Heisenberg Principle



In an R&D orbit, only two of the existing three parameters can be defined simultaneously. The parameters are: task, time, and resources (\$).

1. If one knows what the task is, and there is a time limit allowed for the completion of the task, then one cannot guess how much it will cost.
2. If the time and resources are clearly defined, then it is impossible to know what part of the R&D task will be performed.
3. If you are given a clearly defined R&D goal and a definite amount of money which has been calculated to be necessary for the completion of the task, you cannot predict if and when the goal will be reached.

If one is lucky enough and can accurately define all three parameters, then what one deals with is not in the realm of R&D. ●



## Schedule of MANPRINT Courses for FY 87 and FY 88

### MANPRINT Staff Officer Courses      One-Week MANPRINT Courses

Date	Date
15 Jun 87 - 2 Jul 87	13 - 17 Jul 87
27 Jul 87 - 14 Aug 87	20 - 24 Jul 87*
14 Sep 87 - 2 Oct 87	31 Aug - 4 Sep 87
19 Oct - 6 Nov 87	5 - 9 Oct 87
30 Nov - 18 Dec 87	16 - 20 Nov 87
25 Jan - 12 Feb 88	11 - 15 Jan 88
7 - 25 Mar 88	22 - 28 Feb 88
4 - 22 Apr 88	25 - 29 Apr 88
2 - 20 May 88	23 - 27 May 88
6 - 24 Jun 88	27 Jun - 1 Jul 88
11 - 29 Jul 88	1 - 5 Aug 88
8 - 26 Aug 88	29 Aug - 2 Sep 88
12 - 30 Sept 88	

\* To be held at Ft. Leavenworth, KS.

Information on course allocations can be obtained from HQDA (DAPE-ZAM), Washington, DC 20310-0300. Telephone: AV 225-9213 or COM (202) 695-9213. All courses will be held at the Casey Building, Humphrey's Engineer Support Activity Complex, Ft. Belvoir, VA, unless otherwise indicated.

### GOSES MANPRINT Seminars

All located in Washington, DC

#### Dates:

25 Jun 87  
22 Jul 87  
20 Aug 87

### Meetings of Interest in 1987

#### 22 - 24 September

Automatic Test Equipment International Conference, Wiesbaden, Germany. Sponsored by the National Security Industrial Association. Contact: National Security Industrial Association, 1015 15th Street, N.W., Suite 901, Washington, D.C. 20005. Telephone: (202) 393-3520.

#### 12 - 14 October

Association United States Army Meeting. Washington, DC.

#### 19 - 23 October

Human Factors Society Annual Meeting. New York City, NY. Contact: Human Factors Society, P.O. Box 1369, Santa Monica, CA 90405. Telephone: (213) 394-1811.

#### 30 November - 2 December

8th Interservice/Industry Training Systems Conference (ITSC). Washington, DC. Sponsored by the American Defense Preparedness Association. Contact: American Defense Preparedness Association, Rosslyn Center, Suite 900, 1700 N. Moore Street, Arlington, VA 22209-1942. Attn: IMAS. Telephone: (703) 522-1820.

### HOTLINES

MANPRINT -- (800) 252-1626; in VA: (800) 327-1626; 9:00 a.m. - 4:00 p.m.  
HEL -- COM: (205) 876-2048; AV: 746-2048; 7:30 a.m. - 4:00 p.m.

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